REMARKS

Initially, applicant would like to thank the Examiner for his prompt assistance in forwarding an additional copy of a reference, Handbook of Low and High Dielectric Constant Materials and Their Applications, Nalwa, ed., Academic Press: San Diego 1999, pp. 52-53 (Handbook), to applicant's undersigned representative via facsimile on 13 January 2004.

Upon entry of the present amendment, the claims in the application are claims 1-8, 10-12 and 14-23, of which claims 1, 14 and 18 are independent, and of which claims 14-22 stand withdrawn from consideration as being drawn to a non-elected invention or species.

In the above amendments, claims 1 and the specification are amended to change the language "atomic weight %" to –atomic %-- so as to address the Examiner's concern-objection set forth at item 5 of the Office Action, while claim 9 is cancelled as being redundant and inconsistent with present claim 1. Further, claim 1 is amended to more specifically indicate that the oxygen concentration in the atmosphere is maintained at less than or equal to 1% while the plate-like material is heated to at least 400°C and then lowered to at least 200°C, while claim 3 is amended to reflect that the structural elements defined therein are manipulative of the method, and to indicate that the reducing, heating and continuing steps are conducted in the one baking furnace. Finally, new claim 23 further defines that prior to the reducing step the plate-like material is brought close to the cool plate.

Applicant respectfully submits that all of the amendments presented are fully supported by the original disclosure, including the discussion at pages 5-7 and the paragraph bridging pages 11-12 of the specification. Applicant also respectfully submits that the present amendment does not introduce any "new matter" into the application.

Further, applicant respectfully submits that the above amendments overcome the Examiner's objection set forth at item 3 of the Office Action and the rejection of claims 1-12 under 35 USC 112, second paragraph, set forth at item 5 of the Office Action. Accordingly, it is respectfully requested that the objection and rejection be reconsidered and withdrawn.

Restriction Requirement

As set forth at item 2 of the Office Action, the Examiner has made final the restriction requirement previously applied, whereby claims 13-19 (added in Amendment-B) and claims 20-22 (added in the Amendment of 24 September 2003) are withdrawn from consideration as being directed to a constructively non-elected, patentably distinct invention (or species) from the invention set forth in claims 1-12. It is the Examiner's position that the invention, as previously claimed and presented in the application (claims 1-12), is directed to a method generally involving a raw material such as SOG having a low dielectric constant in which the oxygen concentration is maintained at a low level during formation and processing of a coating film, but not to specific SOG materials prepared from specific reagents, while the new claims 13-22 are directed to several other species of SOG prepared from specific materials or reagents, such as alkoxides. Also, the Examiner indicates that if claims 13-22 had been presented before examination on the merits of claims 1-12, a restriction requirement could have been carried out at that time, and that the lack of entitlement to rejoinder of the withdrawn claims is otherwise reflected by the absence of any allowable generic claim.

Applicant's Response

Initially, applicant hereby elects with traverse the invention/species of claims 1-8 and 10-12 for those reasons set forth in the Amendment of 24 September 2003. Although arguments

were previously presented traversing the restriction, an express election was not made in the last Amendment, as noted by the Examiner at the first paragraph under item 2 in the Office Action.

Additionally, applicant respectfully submits that there is currently a generic independent claim in the application, i.e., claim 1. Although there has not been determination that claim 1 is allowable, the matter is being contested by applicant.

Based on the foregoing, it is again respectfully requested that the restriction requirement be reconsidered and withdrawn.

Art-Based Rejections Under 35 USC §103(a)

1. The Examiner has rejected claims 1, 2 and 9 under 35 USC '103(a) as being unpatentable over You et al. (US Patent Application Publication 2001/0029111) in view of the Handbook of Low and High Dielectric Constant Materials and Their Applications, Nalwa, ed., Academic Press: San Diego 1999, pp. 52-53 (Handbook). It is the Examiner's position that You teaches the claimed invention except for use of a low k dielectric material having a carbon content of 5 to 25 atomic (weight) %, but that persons skilled in the art at the time of the invention would have considered it obvious to modify You's method to include methylsilsesquioxane (MSSQ) as a low dielectric constant material instead of HQS, thus meeting the claimed feature, based on the teachings of the Handbook relating to MSSQ. The Examiner's position regarding other features of the claimed invention remain as set forth in prior Office Actions.

Applicant's Response

Upon careful consideration applicant respectfully traverses such rejection, and submits that claims 1, 2 and 9 are clearly patentably distinct over the You and Handbook references, for

most of those reasons discussed in Amendment-B, which are further discussed below.

Most significantly, applicant respectfully submits that You's disclosed method(s) of forming low dielectric constant coating films does not include the specific temperature-based limitations set forth in present claim 1, which are critical to achieving a reduced dielectric constant as discussed in the present application, and are also critical to achieving a reduced shrinkage rate of the applied coating film as discussed below. On the other hand, such limitations are not made obvious by any other evidence of record including the Handbook, AAPA and the Sloan and Wolf references.

Particularly, applicant again respectfully submits that You's disclosure, when properly considered *as a whole*, does not anticipate or make obvious the limitations of claim 1 that: the oxygen content in the atmosphere surrounding the plate-like material be less than or equal to 1% *before the surface temperature of the material rises to 200°C, and again until the surface temperature lowers to 200°C after having been heated to a temperature above 400°C.*

For example, while You's paragraph [0153], as quoted by the Examiner, briefly and generally mentions heating and cooling steps being conducted in an inert gas environment, applicant respectfully submits that the full context of this paragraph and its location within the section "C. Curing Films" of the publication clearly indicate that the heating and cooling steps referred to are *only those involved in curing* a coating film to achieve a thin film having a lower dielectric constant (such as below about 3.0). The heating and cooling steps mentioned in paragraph [0153] cannot reasonably be considered as all heating and cooling steps conducted at any point in the formation of You's spin-on films.

In this regard, applicant notes the Examiner's argument in the prior Office Action of 24

March 2003 in which the Examiner asserts that the discussion in You's paragraph [0153], "The **combination** of step-ramp curing **and** an inert gas environment for **heating**, high temperature cure, and **cooling** steps can provide thin films with high mechanical strength and minimized oxidation, therefore leading to thin films having lower dielectric constants, such as below about 3.0 (emphasis added by the Examiner)", contradicts applicant's argument that You only uses an inert environment for the curing step and therefore does not use the inert atmosphere during the heating step to 200°C; and that that You's paragraphs [0143] - [0152] are directed to "... such heating steps which occur clearly at temperatures below 200°C. " Again, however, applicant respectfully submits that given the location of paragraph [0153] within section "C. Curing Films" of the publication, and You's discussion that the curing process specifically involves heating and cooling steps conducted in ramp-step fashion, paragraph [0153] can only reasonably be interpreted to encompass You's curing process, rather than all processes his overall method involving heating or cooling. Additionally, applicant respectfully submits that given You's disclosure of haw his inert environment is achieved (within the various processing chambers), the Examiner's asserted interpretation is inconsistent with You's specific discussion that his wafer is removed from the curing chamber and allowed to cool to room temperature, as well as You's discussion that the wafer is moved from the reflow chamber in a heated state and placed into the curing chamber which is preheated to a higher temperature.

Further, applicant respectfully submits that full disclosure of the You patent publication considered as a whole, including paragraphs [0056], [0143] - [0153] and the drawings, show that You's disclosed methods of "Curing Films" do not, in fact, meet or suggest the discussed features of claim 1. In this regard, applicant respectfully submits that the heating steps involved

in the curing of coating films discussed at You's paragraphs [0142] - [0153] do not occur at temperatures below 200°C. The lowest temperature indicated in any of these paragraphs is 250°C, specifically in relation to HQS, while the same or higher temperatures would be used in relation to MSSQ according to the Examiner's proposed modification of You. You indicates that after a film has been spun coated onto a wafer 208, it is subsequently processed by being dried (section A, paragraphs [0137]-[0139]) and reflowed (section B, paragraphs [0140]-[0141]), after which it is cured (section C, paragraphs [0142]-[0156]) by placing the wafer in a baking/curing oven which has been preheated to an elevated temperature (the lowest of which is 250°C), thereafter slowly increasing the temperature to a temperature sufficient to break bonds within the film to allow cross linking, decreasing the temperature back to the original elevated temperature (thus finishing the curing process), and finally the cured wafer is removed from the curing oven and allowed to cool to room temperature. See You's paragraphs [0149] and [0151] where he explains that after a HSQ film has been cured (the curing operation including steps for cooling a film to a point where the curing is complete, where the temperature of the film is ramped down or cooled to 300°C, it is "... removed from the curing oven and allowed to cool to room temperature."

Also in this regard, applicant respectfully submits that the full, fair understanding and teachings of You's disclosure, when properly considered as a whole, is that an inert gas environment is maintained within the various processing chambers, including curing ovens where temperatures are raised and lowered in steps, whereas no such inert gas environment is maintained outside of the processing chambers, including when the films are removed from the curing ovens and simply allowed to cool to room temperature. According to You's complete

disclosure, an inert gas environment is achieved for his various processing steps only in conjunction with processing chambers such as the deposition chambers 100a, 100b shown in his Figs. 1a, 1b (via bias gas inflow sources 124, 126), curing ovens, etc.

You's disclosure indicates that the reflowed wafer is not in an inert atmosphere (oxygen content $\leq$1%) just prior to when it is placed into the curing oven preheated to 250°C or higher, nor is it in an inert atmosphere during the final cooling of the wafer from 300°C to room temperature after curing is complete. is not performed in the inert gas environment, contrary to the requirements of claim 1.

Applicant respectfully submits that the above distinctions are very significant/critical because the present invention including such features achieves significant advantage over conventional processes not only in terms of low dielectric constants of the cured coating film, but also a significantly smaller degree of film thickness reduction (shrinkage). In this regard, applicant encloses herewith a chart and an associated graph showing Film Shrinkage Data of Low O_2 Bake Plate, where the results of film thickness reduction (shrinkage) in the cases where the oxygen concentration was set at 20.80%, 10.00%, 1.00%, 1000ppm and 100ppm, respectively, while the treatment time and temperature was kept the same. As indicated by the data, the difference between the initial film thickness and the baked film thickness can be reduced to an acceptable level in the case where the oxygen concentration was 1.00% or less, according to the discussed features of claim 1. On the other hand, the You reference does not meet or suggest the limitations of claim 1 as discussed above, and does not otherwise address or appreciate the significant advantages as achieved because of same.

Still further, applicant respectfully submits that the Handbook does not overcome the deficiencies of You regarding these critical limitations of claim 1.

Based on the foregoing, applicant respectfully submits that the rejection of claims 1, 2 under 103(a) as being unpatentable over the You and Handbook references is overcome, and accordingly it is respectfully requested that such rejection be reconsidered and withdrawn.

2. At item 8 of the Office Action the Examiner rejects claims 3, 7 and 8 under 35 USC '103(a) as being unpatentable over You et al. in view of the Handbook as applied to claim 1, and further in view of Sloan (US Patent 5,431,700); at item 9 of the Office Action the Examiner rejects claims 4 and 10 under 35 USC '103(a) as being unpatentable over You et al. in view of the Handbook as applied to claim 1 and further in view of applicant's admitted prior art of the dual damascene method shown in Figs. 1(a) - 1(h) (AAPA) and the treatise discussion of Wolf et al. relating to silicon processing through damascene methods; and at item 10 of the Office Action the Examiner rejects claims 5, 6, 11 and 12 under 35 USC '103(a) as being unpatentable over You et al. in view of the Handbook and Sloan as applied to claims 1-3, and further in view of AAPA and Wolf. It is essentially the Examiner's positions regarding the rejections that it would have been obvious to persons skilled in the art at the time of the invention to further modify You's disclosed method by: using the temperature control features disclosed by Sloan for the beneficial reasons discussed by Sloan; and further processing an interlayer insulation layer by a damascene method based on the teachings of AAPA and Wolf which show that such processing is common for interconnecting semiconductor devices; and that You's method thus further modified makes obvious the invention of claims 3-8 and 10-12.

Applicant's Response

Upon careful consideration applicant respectfully traverses such rejection, and submits that claims 3-8 and 10-12 are clearly patentably distinct over the applied art, for those reasons discussed above in relation to claims 1-2, which are not overcome by any additional teaching of Sloan, Wolf or AAPA, noting that Sloan merely teaches an oven which may be used for carrying out You's disclosed curing process, while Wolf and AAPA merely disclose processing of an interlayer insulation layer by a damascene method.

Based on the foregoing, applicant respectfully submits that the rejections of claims 3-8 and 10-12 under 103(a) as being unpatentable over You, Handbook, Sloan, Wolf and AAPA are overcome, and accordingly it is respectfully requested that such rejections be reconsidered and withdrawn.

Conclusion

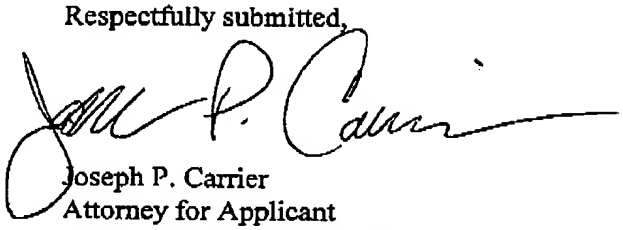
In conclusion, applicant again respectfully request reconsideration of the restriction requirement; applicant has overcome the Examiner's objections and rejections set forth in the Office Action; and moreover, applicant has considered all of the evidence of record, and it is respectfully submitted that the invention defined by each of the present claims is clearly patentably distinct thereover.

The application is now believed to be in condition for allowance, and a notice to that effect is earnestly solicited.

If the Examiner is not fully convinced of all of the claims now in the application, applicant respectfully requests that she telephonically contact applicant's undersigned representative to expeditiously resolve prosecution of the application.

Favorable consideration is respectfully requested.

Respectfully submitted,



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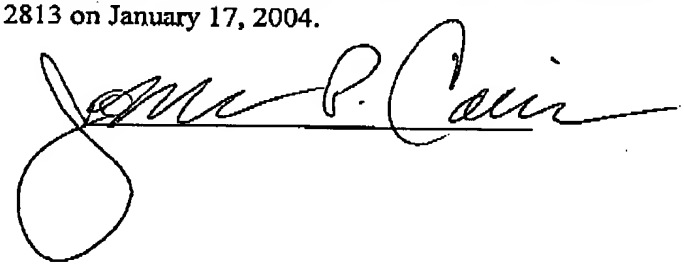


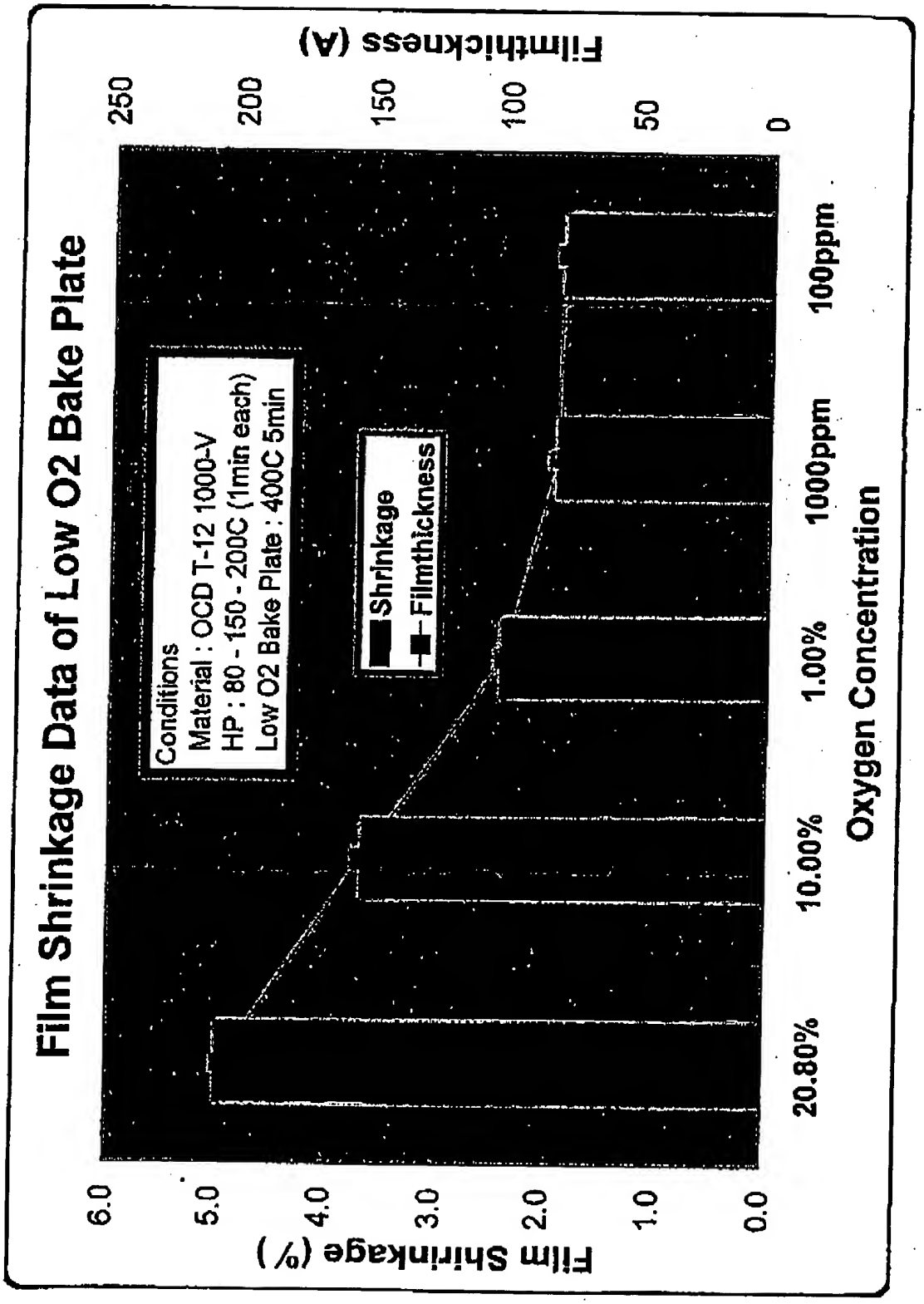
→ claimed range

	20.80%			10.00%			1.00%			1000ppm			100ppm		
	Initial	after H/B	Diff.	Initial	after H/B	Diff.	Initial	after H/B	Diff.	Initial	after H/B	Diff.	Initial	after H/B	Diff.
1	4176.3	3958.8	217.5	4303.7	4132.5	171.2	4250	4159.2	90.8	4182.2	4093.6	86.6	4187.7	4130.3	57.4
2	4089.7	3865.2	224.5	4089.1	3906.7	182.4	4014.7	3961.7	53	4062.3	3988.6	73.7	4057.2	3979.7	77.5
3	4161	3966.8	194.2	4200.5	4047.2	153.3	4179.7	3993.7	186	4156.7	4088.3	68.4	4199.2	4050.2	149
4	4166.3	3954.5	211.8	4159.7	4044.3	115.4	4128	4025.5	102.5	4135.2	4050.8	84.4	4122.2	4061.7	60.5
5	4169.7	3959.6	210.1	4155.5	4033.5	122	4142.2	4019.7	122.5	4125	4066.7	58.3	4129.5	4035.7	93.8
6	4177	3956	221	4239.3	4051.6	187.7	4123.7	4040.7	83	4148.2	4068.2	80	4148.2	4071.7	76.5
7	4132.5	3953	179.5	4186.5	4012.5	174	4128	4055.2	72.8	4150.5	4037.7	112.8	4177.8	4077.7	100.1
8	4020.5	3825.7	194.8	4017.6	3884.7	132.9	3985.3	3876	89.3	3999.5	3927.6	71.9	3912.5	3891.2	21.3
9	3923.3	3732.2	191.1	4088.7	3929.1	138.6	3977.7	3881.1	96.6	3957.3	3881.1	76.2	3896.5	3837.5	59
Av.	4112.9	3908.0	[illegible]	4157.8	4004.7	[illegible]	4101.0	4001.4	[illegible]	4101.9	4022.5	[illegible]	4092.3	4015.1	[illegible]

204.9 153.2 99.6 79.4 77.2

	B	R	A	%
Av. 20.8%	4112.922	204.9444	3907.978	4.98
10.0%	4157.844	153.1667	4004.678	3.68
1.0%	4101.033	99.61111	4001.422	2.43
1000ppm	4101.878	79.36667	4022.511	1.93
100ppm	4092.311	77.23333	4015.078	1.89

	Shrinkage	Filmthickness
20.80%	4.98	204.9444
10.00%	3.68	153.1667
1.00%	2.43	99.61111
1000ppm	1.93	79.36667
100ppm	1.89	77.23333


Film Shrinkage Data of Low O2 Bake Plate
Conditions
Material : OCD T-12 1000-V
HP : 80 - 150 - 200C (1min each)
Low O2 Bake Plate : 400C 5min
Shrinkage
Filmthickness
Film Shrinkage (%)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Filmthickness (A)
250
200
150
100
50
0
20.80%
10.00%
1.00%
1000ppm
100ppm
Oxygen Concentration